

Notice of Allowability

Application No.

10/506,762

Examiner

Andrew Yang

Applicant(s)

HARADA ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 22 December 2006.
2. ☒ The allowed claim(s) is/are 1-5, 7, 9-11, 13 and 15.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|---|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____ |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____ |

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Konomi Takeshita on April 2, 2007.

The application has been amended as follows:

Claim 1 should be amended as follows:

A method for approximating CAD data representing a three-dimensional object by approximating each face of the three-dimensional object with triangular or quadrilateral surfaces within a specified conversion tolerance, comprising steps of:

- (a) generating a mesh with mesh lines for approximating each face of the three-dimensional object represented by the CAD data within a rough conversion tolerance with respect to a-the specified conversion tolerance;
- (b) approximating a boundary edge surrounding and defining each individual face with a plurality of curves within the specified conversion tolerance, approximating each of the curves with a polyline comprising points and connecting lines within the rough conversion tolerance to define boundary points which are the points of the polylines, and obtaining a vector tangential to the curve at each of the boundary points;
- (c) generating polygons with three or four vertices by connecting internal points which are points of intersection of the mesh lines inside the boundary edge, and by connecting

the boundary points and the internal points that are adjacent to and inside the boundary edge;

(d) calculating a vector normal to the face at each of the vertices of each of the polygons, storing information identifying the vertices and the corresponding normal vectors, and storing the tangential vector at each of the boundary points obtained at the step (b);

(e) converting each of the polygons with three or four vertices to a triangular or quadrilateral surface respectively, by using a plurality of control points obtained by processing the information identifying the vertices, the normal vectors, and the tangential vectors; and

(f) examining if each of the triangular or quadrilateral surfaces is close to the face represented by the CAD data within the specified conversion tolerance, and if not, regenerating a mesh with a narrower mesh width and more mesh lines on the face to repeat the steps (c)- (e) and (f); and

generating a mesh with mesh lines for approximating each face of the three-dimensional object within a rough conversion tolerance with respect to a specified conversion tolerance, approximating a boundary edge surrounding and defining each individual face with a plurality of curves within the specified conversion tolerance, and approximating each of the curves with a polyline comprising points and connecting lines within the rough conversion tolerance to define boundary points which are the points of the polylines, for obtaining polygons to be used for approximating each face of the three-dimensional object with triangular or quadrilateral surfaces within the specified

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conversion tolerance;

examining if each of the triangular or quadrilateral surfaces is close to the face

represented by the CAD data within the specified conversion tolerance; and

if not, regenerating a mesh with a narrower mesh width and more mesh lines on the face to obtain polygons;

(m) display switching, comprising steps of:

acquiring display conditions including display shapes and sizes;

determining whether or not a detailed display be performed depending on the display conditions; and

executing steps (j) - (l), if it is determined that the detailed display be performed, or displaying the polygons by use of the polygons data, otherwise,

wherein the steps (j) - (l) are:

(j) receiving and storing information identifying vertices and corresponding normal vectors for each of the polygons, and a tangential vector at each of the boundary points;

(k) tessellating each of the surfaces into sub-polygons, the surfaces having been generated by using control points obtained by processing the information identifying the vertices, the normal vectors, and the tangential vectors stored at the step (j); and

(l) displaying a three-dimensional shape comprised of the sub-polygons,

wherein in the step (e), the control points between two internal points are generated by use of the normal vector at each of the internal points, the control points between one internal point and one boundary point are generated by use of the normal vector at each of the internal and boundary points, and the control points between two

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boundary points are generated by use of the tangential vector at each of the boundary points.

Claim 8 has been canceled.

Claim 9, at line 2, replace "8" with --1--.

Claim 10, at line 2, replace "8" with --1--.

Claim 11, at line 2, replace "8" with --1--.

Claim 13 should be amended as follows:

~~A computer program product~~ computer readable medium encoded with a computer program for use in a computer system for approximating CAD data representing a three-dimensional object by approximating each face of the three-dimensional object with triangular or quadrilateral surfaces within a specified conversion tolerance, comprising:

~~a computer memory medium; and~~

~~commands stored in the computer memory medium for operating the computer system, comprising:~~

a command for generating a mesh with mesh lines for approximating each face of the three-dimensional object represented by the CAD data within a rough conversion tolerance with respect to the specified conversion tolerance;

a command for approximating a boundary edge surrounding and defining each individual face with a plurality of curves within the specified conversion tolerance, approximating each of the curves with a polyline comprising points and connecting lines within the rough conversion tolerance to define boundary points which are the points of

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the polylines, and obtaining a vector tangential to the curve at each of the boundary points;

a command for generating polygons with three or four vertices by connecting internal points which are points of intersection of the mesh lines inside the boundary edge, and by connecting the boundary points and the internal points that are adjacent to and inside the boundary edge;

a command for calculating a vector normal to the face at each of the vertices of each of the polygons, storing information identifying the vertices and the corresponding normal vectors, and storing the tangential vector at each of the boundary points;

a command for converting each of the polygons with three or four vertices to a triangular or quadrilateral surface respectively, by using a plurality of control points obtained by processing the information identifying the vertices, the normal vectors, and the tangential vectors; and

a command for examining if each of the triangular or quadrilateral surfaces is close to the face represented by the CAD data within the specified conversion tolerance, and if not, a command for regenerating a mesh with a narrower mesh width and more mesh lines on the face to repeat the above commands if the condition in which the CAD data is within the specified conversion tolerance is not met;

a command for generating a mesh with mesh lines for approximating each face of the three-dimensional object within a rough conversion tolerance with respect to a specified conversion tolerance, approximating a boundary edge surrounding and defining each individual face with a plurality of curves within the specified conversion tolerance, and

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approximating each of the curves with a polyline comprising points and connecting lines within the rough conversion tolerance to define boundary points which are the points of the polylines, for obtaining polygons to be used for approximating each face of the three-dimensional object with triangular or quadrilateral surfaces within the specified conversion tolerance;

a command for examining if each of the triangular or quadrilateral surfaces is close to the face represented by the CAD data within the specified conversion tolerance; and

-a command for regenerating a mesh with a narrower mesh width and more mesh lines on the face to obtain polygons, if the condition in which the CAD data is within the specified conversion tolerances is not met,

and a display switching command stored in the computer memory medium, comprising:

a command for acquiring display conditions including display shapes and sizes;

a command for determining whether or not a detailed display be performed depending on the display conditions; and

a command for issuing a detailed display command, if it is determined that the detailed display be performed, or for displaying the polygons by use of the polygons data,

otherwise,

wherein the detailed display command includes:

a command for receiving and storing information identifying vertices and corresponding normal vectors for each of the polygons, and a tangential vector at each of the boundary points;

a command for tessellating each of the surfaces into sub-polygons, the surfaces having

been generated by using control points obtained by processing the information identifying the vertices, the normal vectors, and the tangential vectors; and a command for displaying a three-dimensional shape comprised of the sub-polygons,
wherein

the command for converting each of the polygons with three or four vertices to a triangular or quadrilateral surface respectively includes a command for generating the control points between two internal points by use of the normal vector at each of the internal points, generating the control points between one internal point and one boundary point by use of the normal vector at each of the internal and boundary points, and generating the control points between two boundary points by use of the tangential vector at each of the boundary points.

Claim 14 has been canceled.

Allowable Subject Matter

The following is an examiner's statement of reasons for allowance: references by Kato (U.S. Patent No. 6,462,738), Migdal et al. (U.S. Patent No. 6,356,263), Pulli et al. (U.S. Patent No. 6,130,673), and Junkins (U.S. Patent No. 6,650,324) are made of record as describing related methods of generating a control mesh for CAD applications, further subdividing a mesh based on subdivision criteria, editing a mesh surface, and defining surface normals, respectively. However, none of the cited prior art teaches or suggests a method wherein the control points between two internal points are generated by use of the normal vector at each of the internal points, the control points between one internal point and one boundary point are generated by use of the

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normal vector at each of the internal and boundary points, and the control points between two boundary points are generated by use of the tangential vector at each of the boundary points.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Yang whose telephone number is (571) 272-5514. The examiner can normally be reached on 8:30-5 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Zimmerman can be reached on (571) 272-7653. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

A handwritten signature in black ink, appearing to read 'K. M. Tung', with a long, sweeping horizontal line extending to the right.

KEE M. TUNG
SUPERVISORY PATENT EXAMINER